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Catalysts of Economic Innovation

Building on the Applied Research Capacity of Ontario Colleges

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CATALYSTS OF ECONOMIC INNOVATION

Building on the Applied Research Capacity of Ontario Colleges

February 2006

ONTARIO COLLEGES

Association of Colleges
of Applied Arts and Technology of Ontario

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ONTARIO COLLEGES

Catalysts of Economic Innovation:
Building on the Applied Research Capacity of Ontario Colleges

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Catalysts of Economic Innovation

Building on the Applied Research Capacity of Ontario Colleges

EXECUTIVE SUMMARY

Ontario firms and organizations are being challenged to increase productivity through innovation in order to compete on the fiercely competitive world stage and improve the quality of life of Ontarians. *Yet, Ontario suffers from innovation gaps that place its productivity and prosperity goals at risk.*

Ontario's 24 Colleges of Applied Arts and Technology have long been recognized for their contributions to career-oriented education and training programs that have strengthened the Ontario economy throughout the latter part of the 20th century. Poised on the threshold of the 21st century, college-based applied research and development (R&D) and business and industry innovation activities are of ever increasing importance to the achievement of Ontario's productivity and prosperity goals.

Colleges recommend that, beginning in 2006/07, the Government of Ontario establish a new, forward-looking provincial research and innovation policy framework and launch three strategic programs to bolster college capacity to support business and industry through applied R&D, innovation and commercialization activities over the next decade, at a cost of $50 million over first five years.

Ontario's college capacity for applied research and innovation is an underutilized resource to achieve Ontario's productivity and prosperity goals. Ontario colleges offer:

- A proven return on investment in applied R&D and innovation;
- An array of connections to industry and community organizations;
- Regional proximity to industry clusters;

- Unique value-added in the research "market-place";
- Experience in applying new knowledge to solve industry problems and achieve industry goals;
- Personnel with expertise and experience across key sectors of the economy;
- The ability to rapidly move innovative ideas through the early stages of development and commercialization;
- State-of-the-art facilities, equipment and space to support the development of new products and applications; and
- A sustained commitment to a culture of innovation.

Systemic barriers that currently limit the degree to which colleges can contribute to the future achievement of Ontario's productivity and prosperity goals include:

- A permissive but not enabling provincial policy framework for college applied R&D and innovation;
- No operating funding for Ontario colleges supporting applied research activities, resulting in:
  - A shortage of funds to strengthen colleges' institutional capacity to initiate, undertake and manage applied R&D and innovation projects that respond to industry and community needs in a timely way;
  - A shortage of funds to support college personnel conducting applied R&D and innovation projects; and
  - A shortage of funds to enable college applied R&D personnel to rapidly establish partnerships to address applied R&D challenges and to sustain and foster long-term relationships with key personnel from business, industry and community organizations.

To strengthen provincial economic competitiveness and prosperity, Ontario colleges are calling on the government of Ontario to:

- Move beyond merely "permissive" policies in relation to applied R&D and innovation activities at Ontario colleges and develop a formal provincial policy and investment framework that recognizes and enables the unique roles colleges can play in support of applied R&D and business and industry innovation activities;

- Explicitly develop Ontario colleges' applied research, innovation and commercialization capacity; and

- Enable colleges to increase their capacity for applied R&D and innovation partnerships with business, industry, federal and provincial governments, and com-

munity organizations.

Specific action is required on the part of government to:

- Optimize Ontario's economic competitiveness and prosperity through the creation of an explicit provincial strategy to increase institutional capacity available to support applied R&D, innovation and commercialization activities at Ontario colleges;

- Release the creativity and applied research and innovation capacity of Ontario colleges for the benefit of Ontario businesses, industries, and community organizations by enabling college researchers to engage in high priority applied R&D, innovation and commercialization activities; and

- Leverage partnerships between college personnel and business, industry and community organizations that a) are purposeful, timely and oriented toward applied research problem identification or solutions; and b) promote increased networking, information sharing and relationship-building across sectors through college-industry-community residency programs.

Specific recommendations include:

1. Enunciate an explicit provincial policy framework supporting college applied R&D and innovation capacity development

Develop a formal provincial R&D/innovation policy and investment framework that recognizes and enables colleges to develop their unique capacities in applied R&D, innovation and commercialization.

2. Enable a College Applied R&D Services Development (CAR&DSD) Program

Optimize Ontario's economic competitiveness by supporting colleges seeking to increase their institutional capacity to initiate, undertake and manage applied R&D, innovation and commercialization projects in response to industry and community needs.

3. Establish a College Applied R&D Personnel (CAR&DP) Program

Unleash the full potential of colleges to contribute to economic development and social well-being by funding college personnel conducting applied R&D, innovation and commercialization projects.

4. Initiate a College Interactions for Innovation (I for I) Program

Strengthen regional economic and social development by enabling college applied R&D personnel to rapidly establish partnerships to address applied R&D problems and foster the development of long-term relationships with key personnel from business, industry and community organizations.

The annual cost of these programs is estimated to be $6 million in Year I of funding (2006/07), increasing to $18 million in Year V (2010/11), for a total budget of $50 million in the first phase of a two-part, 10 year capacity building strategy.
In 1994, an Ontario government advisory body estimated that nearly $1 billion of the provincial operating grant for Ontario universities for 1992/93 was used for university research activities (primarily salary support).

By enabling colleges to effectively assume the role of industry and community catalysts for applied R&D and workplace innovation, the Ontario government will address systemic barriers that otherwise place at risk Ontario's goals for increased productivity through innovation.

The applied R&D capacity building strategy proposed for Ontario colleges will launch a decade of development that will solidify colleges' roles as community based catalysts of innovation. It will also position colleges as anchor organizations in over 200 communities that engender the flourishing innovative culture the government of Ontario aims to advance.

1. CURRENT CHALLENGES TO ONTARIO'S PRODUCTIVITY AND PROSPERITY

Ontario firms and organizations are being challenged to increase productivity through innovation in order to flourish in fiercely competitive world markets and improve the quality of life of Ontarians. *Yet, Ontario suffers from innovation gaps that place its productivity and prosperity goals at risk.* For example:

Fewer than 1.5% of Ontario employers do any research and development (R&D) in spite of the introduction of significant R&D financial incentives, low costs for research personnel and high levels of support for government and university research.

Ontario's very narrow industrial R&D focus (primarily information and communications technology and biotechnology) misses many industries central to Ontario's future development.

Ontario's industrial R&D is concentrated in a few large cities. Many communities and regions require help stimulating innovation across sectors, firms and organizations if they are to prosper in the face of global competition.

Public investment in research is primarily earmarked for basic, investigator-initiated research intended to discover new knowledge. In 1994, an Ontario government advisory body estimated that nearly $1 billion of the provincial operating grant for Ontario universities for 1992/93 was used for research activities (primarily salary support). At that time, this amount represented 43% of the Ontario government "Block Grant" to universities and 59% of the Ontario government "Tied Grants" provided to universities.[1]

Research knowledge is often incomplete and rooted in abstract principles that do not lend themselves to concrete applications in products and services without significant additional effort and investment.

The gap between research knowledge and its use is too long and too wide and the public investments in research to date have not generated acceptable returns. Recent Statistics Canada data (November 2003) reveal that while university income from intellectual property (IP) in 2003 was $55.5 million, the administrative costs of IP commercialization were $36 million, which net the economy only $19 million on a total investment in university research of $7.5 billion.[2]

Ontario colleges wish to recognize and commend the current government's efforts over the past year to implement policies and programs that advance Ontario's research, development and commercialization capacity, and for including Ontario colleges in both the policy development and implementation process. Public investments in research and research infrastructure constitute a critical source of support to Ontario's firms and organizations. Universities, colleges, teaching hospitals, and other public research organizations each play a role in meeting the need for highly qualified personnel and in facilitating innovation that leads to new products, processes, companies and jobs.

However, to reduce the gap between research knowledge and its use, the Ontario government must actively plan for the translation of research knowledge into useful information and know-how that makes sense to people in firms and organizations. In order to catalyse the development of new and improved products and services that will increase productivity, firm competitiveness, and/or social benefits, government must engage people and organizations that can:

- Effectively customize research knowledge to meet specific needs;
- Facilitate proof-of-concept projects through observable results that can be scaled up rapidly;
- Test innovations on a small scale to reduce uncertainty about their value and cost.

Ontario's 24 Colleges of Applied Arts and Technology (CAATs) can perform a vital role in rapidly translating research knowledge into new products, services and processes that bolster firm competitiveness, enhance productivity and improve quality of life for Ontarians.

2. ONTARIO COLLEGES ARE AN UNDERUTILIZED COMPONENT OF ONTARIO'S RESEARCH AND INNOVATION STRATEGY

Ontario colleges employ over 6,000 full-time teaching personnel in a variety of roles that, working together, provide affordable, accessible and economically relevant learning opportunities for a broad cross-section of Ontario society.

An estimated 2% of Ontario's full-time college faculty engage in applied research, development and commercialization activities and about 20% of college faculty hold research-based master's or doctoral degrees.

Ontario colleges project that within a decade, and with adequate funding, 10% or over 600 full-time faculty will be involved in applied research and development activities at any given time.

Ontario colleges enroll 150,000 full-time and 350,000 part-timer learners in over 200 communities across Ontario. Colleges serve 52% more students than were served 15 years ago[3], and offer programs across six major discipline areas[4]:

Table 1: Proportion of College Graduates by Program

Discipline Areas	% Graduates per year
Business	26%
Community Service	23%
Engineering Technology	18%
Health Science	16%
Creative and Applied Arts	12%
Hospitality	5%

In addition, there are 10,000 business and industry advisors working closely with colleges to ensure that their teaching, apprenticeship and training programs are focused on meeting societal needs and solving real-world problems that directly address the needs of the Ontario economy.

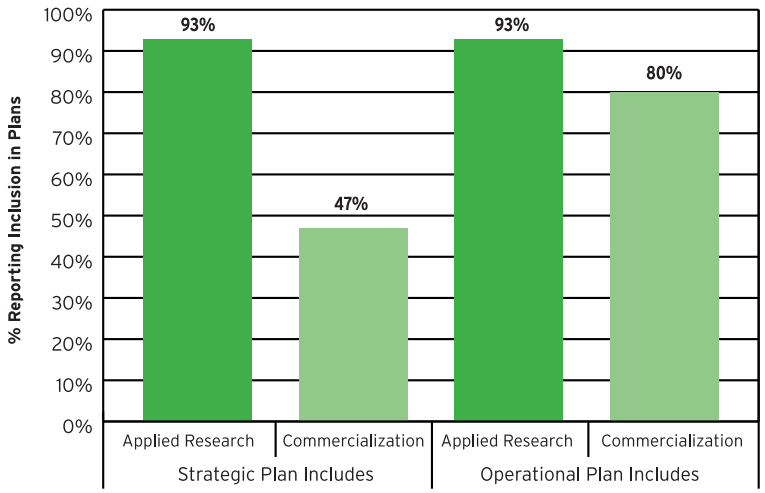
The Province's current investment in Ontario colleges generates an annual return of $1.2 billion, or 12.1%, which represents a benefit/cost ratio of 2.3:1.[5]

While the core role of colleges has been and will remain providing workforce training and retraining to meet industry and community needs, since the early 1990s, colleges have been increasingly engaging in applied R&D and innovation activities. Over the past decade, Ontario colleges have assumed new, specialized roles with respect to applied R&D, innovation, participation in networked research programs, and training entrepreneurial personnel. Following legislative recognition of applied research as part of the official mandate of Ontario colleges in 2002, colleges have continued to expand their applied R&D activities in collaboration with industry and community partners.

A recent survey conducted by CON*NECT in September 2004[6], revealed that applied R&D and commercialization activities have been incorporated into a majority of colleges' strategic and operational plans as part of their overall approach to meeting the full range of business, industry and community needs.

For example, the survey revealed that applied research is specifically mandated in 93% of respondents' strategic and operational plans. Commercialization is specifically mandated in 47% of respondents' strategic plans and 80% of their operational plans.

Figure 1: Degree to which Applied Research and Commercialization is Mandated in College Official Plans (N=15)



Other key survey findings include (N=15 colleges):

Colleges are active in applied research fields that are key to Ontario's economic growth and prosperity:

- 80% of respondents undertake applied research in the field of Information and Communication Technologies
- 53% of respondents are involved in applied research in the fields of Materials and Manufacturing Technologies; Health and Life Sciences; and Environmental Technologies.
- 40% of respondents are involved in applied Humanities research related to Aboriginal issues, education, and the travel industry.
- 27% of respondents are involved in applied research related to Energy, as well as "Other" fields including Management, Education, Sociology and Psychology.
- 20% of respondents noted involvement in Media-related applied research activities.

The majority of respondents have processes in place to assess research ethics.

- 73% of respondents had some form of research ethics review process in place.
- 27% of respondents had no ethics review processes in place. However, 50% of these respondents were in the process of developing such processes.

The majority of respondents have specific policies to manage research accounts and personnel.

- 73% of respondents had research-specific accounting policies and procedures. 60% of respondents had research-related human resource and staffing policies and procedures.
- 7% of respondents used existing, non-research-specific policies to address research accounting and personnel matters.

Managing IP policy preparedness re: IP disclosure, ownership and management are approaching 100% of respondents.

- 73% of respondents had IP disclosure policies in place. Another 20% of respondents had policies pending, which will bring the total to 93%.
- 87% of respondents had IP ownership policies in place. Another 13% of respondents had policies pending, which will bring the total to 100%.
- IP ownership policies typically vest IP ownership with the College. 73% of respondents had IP management policies. Another 20% of respondents had policies pending, which when implemented would bring the total to 93%.

The majority of respondents have personnel responsible for IP and technology transfer issues.

- 60% of respondents had personnel dedicated to technology transfer and IP-ownership and protection.
- The level of these positions included Applied Research Manager; Director, Research and Innovation; Associate Vice-President Research and Innovation; and Vice-President Finance.

The majority of respondents have strategies in place for managing and/or facilitating commercialization of applied research outcomes.

- 47% of respondents had designated in-house offices to manage and facilitate commercialization activities.
- 27% of respondents (which includes some respondents with in-house offices) indicated that they out-sourced the management and facilitation of commercialization activities.
- 40% of respondents provided neither in-house nor out-sourced management of commercialization activities.

Personnel solely dedicated to technology transfer and commercialization matters are scarce.

- 13% of respondents indicated that they had dedicated technology transfer personnel on staff that manage and facilitate commercialization activities.
- The majority of colleges undertaking in-house management and facilitation of commercialization-related activities designated responsibility for managing and facilitating commercialization to individuals who had multiple institutional responsibilities.

In support of their applied R&D activities, Ontario's colleges have been investing for over a decade in the institutional capacity necessary to undertake and manage projects across a range of areas of strategic importance to the Ontario economy. As noted above and illustrated in Appendix A, Ontario colleges are engaged in applied research initiatives across all areas of provincial priority, including:

Biotechnology
Economic Development
Energy
Environmental Sustainability and Protection

Information and Communication Technologies
Life Sciences
Materials and Advanced Manufacturing, and
Social Services.

Applied research at Ontario colleges includes innovation and commercialization-related activities such as:

- Demonstrating proof-of-principle;
- Building and testing prototypes;
- Carrying out non-routine laboratory testing or field studies that have application potential;
- Developing new and enhanced products and processes;
- Bringing new knowledge to market to expand market opportunities for small and medium-sized enterprises (SMEs) as well as global corporations; and
- Working closely with industry to support the adoption of innovations that promote regional economic development.

During the brief time that Ontario colleges have had applied research as part of their official mandate, they have demonstrated that their R&D outcomes have much to offer in terms of economic development and commercialization impact, innovation, job creation and the development of highly skilled entrepreneurial personnel.

For example, college applied research and innovation projects funded in 2003 by the Communications Information Technology Ontario (CITO) Network, a member of Ontario Centres of Excellence Inc., demonstrated that Ontario college applied R&D and innovation initiatives:

- Generate higher than average support and investment from industry partners
  –the 2:1 ratio of industry to CITO investment exceeded expectations;
- Yield a high rate of commercializable intellectual property
  –four of the five funded projects [80%] are actively pursuing commercialization of results;
- Provide OCEs with an applied research and innovation investment strategy that is

highly responsive to industry needs

–*the core functions of Ontario colleges are inextricably linked to the needs and challenges of Ontario industry - longstanding local, regional and provincial linkages between colleges and industry are already in place; and*

- Provide OCEs with a vehicle for investment where applied research can be readily undertaken within industry timeframes and where researchers share with industry an emphasis on applicability, cost-control and sustaining industry competitiveness

  –*Ontario colleges have facilities, expertise and a culture that is already aligned with industry priorities.*

In addition, college applied R&D and workplace innovation activities have positively impacted the healthcare, environmental, and public policy fields. For example, college applied R&D and workplace innovation initiatives have led to:

- The design and implementation of on-line education programs tailored to meet the professional development and skills enhancement needs of health care and public health workers, patients, teachers, and industry employees (Algonquin, Boreal, Cambrian, Centennial, Seneca);

- Innovations in healthcare and the training of allied health professionals (Durham, Seneca)

- The development of systems that measure air quality and link measures to health risks in the community (Fanshawe);

- New applications for alternative energies and means of energy conservation (Algonquin, Boreal, St. Lawrence, Lambton);

- The development of virtual reality systems to facilitate municipal, regional and provincial land use planning decisions, positioning Canada at the forefront of 3-D visualization initiatives (Niagara);

- Innovations in the construction of residential housing (Algonquin, Conestoga, St. Lawrence); and

- Innovations in Aboriginal community policies and programming (Sheridan).

Investments in college applied R&D and business and industry innovation are an important component of a provincial strategy to achieve Ontario's research and innovation goals given Ontario colleges':

Proven return on investment for college applied R&D:

Array of connections to industry and community organizations;

Regional proximity to industry clusters;

Unique value-added in the research "market-place";

Experience in applying new knowledge to solve industry problems and achieve industry goals;

Personnel with expertise and experience across key sectors of the economy;

Ability to rapidly move innovative ideas through the early stages of development and commercialization;

State-of-the-art facilities, equipment and space to support the development of new products and applications; and

Sustained commitment to a culture of innovation.

As illustrated in Appendix B, Ontario colleges have a range of partners across sectors with which they conduct applied R&D, commercialization and workplace innovation initiatives. The benefits that accrue to these organizations and society include:

All economic sectors: Colleges work with their partners to strengthen their ability to conduct market-driven applied product and process R&D in Ontario.

Small and medium enterprises (SMEs): Colleges help SMEs learn to innovate – from the identification of new products and improved processes, to the development of better skilled people to ensure flawless execution.

Communities: Colleges strengthen community economic development by working with private and public sector organizations to meet their applied R&D and

innovation needs.

Preparation of the workforce of the future: Colleges strengthen their learners' understanding of innovation and entrepreneurship and educate the public about the rewards of careers in technology.

Governments world-wide acknowledge that the research base of their economies is a critical source of competitive advantage. Experience has shown that the principal economic benefits from research accrue largely to firms that are located near research facilities, near other firms in the same sector, and near colleges and universities in a geographic cluster. The economic benefits of the "spillover effect" arising from geographic proximity have altered economic development strategies pursued by some US states and Canadian provinces.

"We need to keep our eye on the places that are working hard and nurturing creativity – because those are the key elements of global competition".

Premier Dalton McGuinty
Minister of Research and Innovation

ww.mri.gov.on.ca/english/strategy_21_Oct_2005/other.asp

Over the past 25 years, governments have endeavoured to recreate the geographic proximity and inter-relationships among research, business, industry and community organizations that underpinned the conditions for success of Silicon Valley. Such conditions have been widely replicated in Austin, Texas; San Diego, California; the North Carolina Research Triangle; the Georgia Research Alliance and are being attempted by the Toronto Region Research Alliance and the establishment of provincial Research Innovation Networks (RINs) program.

However, policy initiatives in other provinces recognize the unique research and innovation capabilities of their colleges and provide special funds to promote college research, development and innovation capacity. For example, British Columbia, Alberta and Quebec have taken measures to fully utilize colleges/CEGEPS within their provincial innovation strategies, and the colleges in these provinces are enabled through targeted provincial funding programs that support college personnel for time spent participating in research partnerships with universities and industry as part of local and regional economic development strategies. Appendix C provides a brief summary of strategies and initiatives adopted in British Columbia, Alberta and Quebec.

Ontario colleges have a unique approach to research, tackling real world problems from an applied perspective, and most often in collaboration with partners seeking to commercialize or innovate in response to competitive pressures in the market-place. Ontario colleges have the potential to significantly broaden the current spill-over effect of R&D investments in the postsecondary sector to the benefit of

local and regional economies because of their culture of responsiveness to market-demands and their ubiquitous geographic presence, which maps directly onto the existing clusters of traded industries across Ontario.[7]

Ontario colleges have particular potential to help SMEs address the unique challenges that they face. As suppliers to larger enterprises, SMEs are often under tremendous pressure to improve quality and reduce prices. Managing such pressures drives SMEs to seek a combination of technical assistance and support for human resource and training issues that only colleges can provide.[8]

Ontario colleges have demonstrated that they have the people, the partners and the facilities to undertake applied R&D and facilitate business and industry innovations. With appropriate levels of project funding and institutional overhead and operating support, colleges can readily contribute more to the competitiveness of SMEs, strengthen community infrastructure, benefit the environment, create jobs, and help move new products and services to market in a timely fashion.

3. SYSTEMIC FACTORS LIMIT THE IMPACT OF COLLEGES ON PRODUCTIVITY AND PROSPERITY

Ontario produces 1% of the world's research and development outputs.[9] While a proportion of Ontario companies can and do assume the risks inherent in global operations, most Ontario companies rely on a steady stream of small, incremental innovations to their business, organization and manufacturing processes and practices to remain competitive. The need for organization, industry and sector innovation is a need to which colleges are ideally suited to respond.

As a result, industry and business have, to an increasing degree, sought out college personnel and facilities to assist with applied R&D and innovation activities. Ontario colleges have responded to the degree possible, within existing resources.

Current funding arrangements for research at Ontario's publicly funded postsecondary institutions generally assume that colleges have the resources to cover research operating funds such as salaries, materials, teaching relief and overheads so long as the direct costs of research are funded externally. However, this is not the case for Ontario colleges. No operating funding is provided to Ontario colleges supporting applied research activities.

Demand for Ontario college applied R&D and innovation support currently exceeds both the supply and the capacity of Ontario college resources. While trying to increase their capacity for applied R&D in order to remain in step with societal needs and the local and regional demand of firms, colleges are not enabled by government policies to engage in such activities because no funds are provided for the operating costs and overhead necessary to plan, manage and undertake college-based applied R&D and innovation.

In short, Ontario colleges are an underutilized resource within the matrix of factors that promote and support productivity gains in firms and organizations across a range of sectors. In addition, Ontario colleges are unable to expand their applied R&D and innovation activities to the degree necessary to meet demand because they *face systemic barriers to the number of personnel, facilities and institutional resources that they can allocate to applied R&D, innovation and commercialization activities.*

While university operating grants cover both the teaching and core research activities of faculty, the provincial operating grant to colleges funds only teaching.

Colleges' need for teaching release support typically go unrecognized within publicly funded research programs, which assume that applicants operate in the funding framework of universities, where research overheads and indirect costs are largely supported by institutional operating funds.

Although Ontario colleges have an applied research mandate, colleges undertaking research incur the full costs of faculty release from teaching loads as well as the direct and indirect costs of research and research infrastructure.

Without ear-marked support from the province to enable colleges to fulfil their applied R&D and innovation mandates, further expansion of college applied R&D and workplace innovation initiatives will be stymied. Colleges cannot redirect resources intended for classroom teaching and training toward applied R&D and innovation activities. Teaching and training of the workforce of the future are critical roles that both government and society depend on colleges performing to the best of their ability now and in the future.

However, to meet the demands of the 21st century, colleges must expand their applied R&D, innovation and commercialization activities to meet the needs of their private- and public-sector partners in business, industry and community organizations. Lacking the capacity to do their own applied research and development, these firms and organizations have turned to Ontario colleges, with whom they have often had successful education and training relationships, for applied research and commercialization support. College expertise and infrastructure help partners improve existing processes and practices, solve specific problems, or adopt/adapt innovations to the Canadian market and/or climate.

Colleges can point to numerous examples of having successfully conducted applied R&D that led to the commercialization and use of new products and services. Yet, of necessity, colleges are conducting applied R&D and facilitating workplace innovation on an *ad hoc* basis, competing in a research funding environment that still strongly favour idea-inspired research. It is now time for government to help colleges move beyond the "making do" phase in respect to their applied R&D activities.

Provincial programs must address systemic barriers to college applied R&D and workplace innovation that currently place at risk the achievement of Ontario's goal to increase productivity through innovation.

4. RECOMMENDATIONS

Ontario's colleges call upon the Government of Ontario to address systemic barriers to the expansion of college applied R&D and workplace innovation activities in order to broaden the base for applied R&D and innovation across Ontario. Colleges must contribute to their potential in order to ensure Ontario's industries and SMEs can increase their productivity and compete effectively in world markets.

Ontario's college system was designed four decades ago to provide the Ontario economy with a unique 20th century competitive edge. College-credentialed workers are the backbone of Ontario's export manufacturing industry. They play a critical role in high productivity industries, in building and operating strategic infrastructure and in the distribution and logistics industries. They are critical to the economic development prospects of the 200 communities in which they have a presence.

If colleges continue to develop their capacity to facilitate innovation and conduct applied R&D, they will provide Ontario with a unique 21st century competitive edge.

To strengthen provincial economic competitiveness and prosperity, Ontario colleges are calling on the government of Ontario to:

- Move beyond merely "permissive" policies in relation to applied R&D, innovation and commercialization activities at Ontario colleges and develop a formal provincial policy and investment framework that recognizes and enables the unique roles of colleges;

- Invest directly in the development of Ontario colleges' applied research, innovation and commercialization capacity; and

- Invest in college capacity to increase applied research, innovation and commercialization partnerships with business, industry, federal/provincial governments and/or community organizations.

In addition to enunciating an explicit and supportive policy and investment framework within which Ontario colleges can undertake applied R&D and innovation, specific programs are recommended for immediate implementation in order to:

- Optimize Ontario's economic competitiveness and prosperity through the creation of an explicit provincial strategy to **increase institutional capacity** available to support applied R&D, innovation and commercialization activities at Ontario colleges;

- Release the creativity and applied research and innovation capacity of Ontario colleges for the benefit of Ontario businesses, industries, and community organizations by enabling **college researchers to engage** in high priority applied R&D, innovation and commercialization activities; and

- Leverage **partnerships** between college personnel and business, industry and /or community organizations that a) are purposeful, timely and oriented toward applied research problem identification or solutions; and/or b) promote increased networking, information sharing and relationship-building across sectors through college-industry-community residency programs.

Specific recommendations for implementation beginning 2006 through to 2011 are outlined below:

Recommendation 1: Enunciate an Explicit Provincial Policy Framework Supporting College Applied R&D and Innovation Capacity Development
Develop a formal provincial R&D/innovation policy framework that recognizes and enables colleges to develop their unique capacities in applied R&D, innovation and commercialization.

Recommendation 2: Enable a College Applied R&D Services Development (CAR&DSD) Program
Optimize Ontario's economic competitiveness by supporting colleges seeking to increase their institutional capacity to initiate, undertake and manage applied R&D, innovation and commercialization projects in response to industry and community needs.

Recommendation 3: Establish a College Applied R&D Personnel (CAR&DP) Program
Unleash the energy of colleges for economic development and community well-being by funding college personnel conducting applied R&D, innovation and commercialization projects.

Recommendation 4: Introduce a College Interactions for Innovation (I for I) Program

Strengthen regional economic and social development by enabling college applied R&D personnel to rapidly establish partnerships to address applied research problems and foster the development of long-term relationships with key personnel from business, industry and community organizations.

Program details, tailored specifically to the developmental needs of Ontario colleges, are provided in the following pages for Recommendations 2 through 4:

RECOMMENDATION 2:
College Applied R&D Services Development (CAR&DSD) Program

Description
This program provides base funding wherein Ontario colleges can enhance their applied R&D, innovation and commercialization capacity, which is essential to the initiation, management, administration, evaluation and support of such activities.

Objective
To strengthen local/regional economic development and applied research problem-solving and innovation capacity across Ontario by increasing Ontario colleges' ability to initiate, undertake, manage and evaluate applied R&D and innovation projects and networks.

Strategic Importance
This program will enable Ontario colleges to increase their applied research management, support, administration and evaluation capacity, to better facilitate innovation within and among Ontario firms and organizations, and to participate more effectively in provincial and federal research granting council programs.

Use of Funds
College Applied R&D Services Development Program grants can be applied toward the college costs for activities supporting applied research and innovation, including:

- Planning, policy and protocol development, management, evaluation, and legal support for applied research activities and related contracts;
- Scanning the external environment for funding and partnership opportunities;
- Reviewing, approving and processing all applied research projects on behalf of the college;
- Supporting liaison between the college and funding agencies;
- Supporting the development of grant applications and administration;
- Reviewing grant/contract terms and conditions;
- Reviewing agreements between students engaged in applied research, the college and any third parties related to intellectual property and ownership, integrity and commercialization rights;
- Validating and reporting on the financial status of research expenditures against approved budgets;

- Obtaining materials, databases access and/or membership fees, supplies and equipment essential to the operation of an applied research services office;
- Undertaking appropriate internal and external reviews consistent with commonly accepted best practices for research integrity, ethical review of research involving humans and stem cells, and assessment of research with potential for biohazards or biosafety risks, and environmental impact;
- Providing IP protection and exploitation support for applied research results;
- Providing networking support (e.g. participation in meetings, teams, sector-wide events) and undertaking regular interactions with industry partners, research teams and consortia in areas of economic priority identified by the Province;
- Organizing, promoting and conducting knowledge translation, transfer and outreach activities targeted to employers, communities, and high schools, including youth outreach initiatives that communicate existing and new applied research and innovation findings and opportunities to Ontario youth.

Application Procedures

The program would be available only to Ontario Colleges of Applied Arts and Technology. Applications would be submitted to the Ministry of Research and Innovation.

Selection Criteria

Applicants must demonstrate the following:

- A baseline status report for applied R&D and innovation support services capacity in the college;
- An institutional plan for the development of applied research and related support services at the college, consistent with institutional strengths and local, regional and provincial needs;
- Institutional commitment to cover specific indirect costs including utilities, building maintenance and renovation, computing services infostructure, library, and college-wide administrative and financial services;
- Evidence of demand for increased applied research capacity from current and/or future applied research partners;
- Evidence of an industry-led, external advisory body to oversee the development of the applied research support strategies and services to ensure relevance to local and regional social and economic needs for innovation and economic competitiveness.

Renewal
This program is part of a proposed 10 year strategy aimed at building applied research and innovation capacity at Ontario colleges.

Following the first five years of funding, a review of the effectiveness of the program would be undertaken.

Subject to the outcome of a program-wide review, satisfactory performance and compliance with reporting practices by individual college participants, and approval of an updated institutional plan for the development of applied R&D and innovation support services, funding may be renewed for an additional five year period.

Budget per institutional application:
$250,000 to $600,000 per year for up to five years, renewable for an additional five years. (Annual allocations may vary by activity level over each five-year funding period.)

Resource Needs
Year I funding of $3 million in year one, growing to $7 million in Year V.

Expected Results
- Position Ontario colleges as regional catalysts that have professional support capacity for applied R&D and innovation activities;
- Make applied research capacity and support for innovation accessible to a much wider range of businesses, industries, organizations; strengthen community based regional innovation networks;
- Leverage the existing training services of colleges into applied R&D opportunities that stimulate local economic development and market competitiveness.

RECOMMENDATION 3:
College Applied R&D Personnel (CAR&DP) Program

Description
This program will address systemic limitations on the degree of college participation in applied R&D, innovation and commercialization by providing funding for college personnel involved in applied R&D projects and programs supported by eligible federal, provincial, private and charitable research funding grants that do not include salaries as an eligible expense.
Use of funds would be restricted to supporting salaries and benefits of college personnel conducting applied research (Colleges do not have core operating funds to cover such costs) that are not covered by the research grant received.

Objective
To make the applied R&D and innovation capacity of Ontario college personnel accessible to Ontario businesses, industries, and community organizations when and where the need for applied R&D and workplace innovation arises.

Strategic Importance
This program is part of a 10-year strategy aimed at building applied R&D, innovation and commercialization capacity at Ontario colleges.
A program is needed to ensure that colleges have resources to cover the salary and benefits costs of personnel conducting applied research at Ontario colleges.
Currently, Ontario colleges receive no salary support for college personnel conducting applied research, despite the fact that applied research was recently added to the college system mandate by the Ontario government. This represents a significant systemic barrier to the development of college applied research capacity.

Application Procedures
The program would be available only to Ontario Colleges of Applied Arts and Technology. Applications would be submitted to the Ministry of Research and Innovation.

Selection Criteria
All applicants must provide to the Ministry of Research and Innovation:
- Proof of funding award from a federal, provincial, private or charitable research funding body.
- Justification for the funding requested for each project.

Budget
Eligible institutions would receive funding up to a maximum of $200,000.00 per eligible research project/program.

Resource Needs
Year I funding of $2 million per year, increasing by year V to $6 million per year.

Results Expected
- Equip Ontario colleges to compete more effectively for federal research granting council funding;
- Stimulate applied R&D and workplace innovation initiatives in the 200 communities where colleges are located;
- Make college researchers more accessible to Ontario firms and organizations that could benefit from applied R&D and innovation results, but are not equipped to independently conduct applied R&D.

RECOMMENDATION 4:
College Interactions for Innovation (I for I) Program

Description
This program will enable college applied researchers to partner on problem identification and solutions in a timely way with key personnel from business, industry and not-for-profit organizations and to foster long-term relationships with key individuals, firms and organizations outside the college.

The Ontario College "I for I" Program consists of two parts:
1) a "just in time" program of support that provides for relatively small amounts of funding to address immediate applied research needs of business and industry, with a quick turnaround of funding approval; and
2) a college – industry reciprocal residency program.

Eligible objects of expenditure include:

- Establishment of a collaborative college-business, industry or not-for-profit organization "SWAT"-team to rapidly diagnose technical problems faced by business, industry or community organizations;

- Business, industry and community organization personnel residency in a college applied R&D/innovation project for up to one year;

- College personnel residency in business or industry settings to enable college researchers to gain in-depth appreciation of the challenges facing a firm, organization, industry or sector and to participate in applied research team-based problem-solving for up to one year focused on a specific problem(s);

- Other college – business, industry and community organization collaborations that create proximity between organizations and colleges and have the potential to catalyze mutually beneficial applied research collaborations leading to innovation and industrial, economic or social benefits to Ontario.

Objective
To build on existing linkages between colleges and local and regional businesses and traded clusters of industries across Ontario so as to strengthen, broaden and deepen the ties between people and organizations that facilitate regional partnerships,

collaborations and alliances underlying creative and innovative economies.

Partner Eligibility
The applied research partner organization must contribute (in cash and/or in-kind) to the direct costs of the project or proposal in an amount equal to 50% of the amount requested from the Program.

A copy of the agreement between the partner and the college must be provided to the Ministry of Research and Innovation for review before funds can be released to ensure that the knowledge and expertise arising from the project can be used to the benefit of Ontario's economy/society.

Strategic Importance
The program will support applied R&D, innovation and commercialization initiatives with potential to impact economic competitiveness and quality of life. It will enable colleges to assist organizations facing urgent challenges related to product or service problem identification, proof-of-concept confirmation and market innovation needs.

By enabling college personnel to take up residency in organizations, the program will also increase awareness on the part of college personnel of the unique challenges, knowledge, applied R&D and training needs facing Ontario's businesses, industries and community organizations.

Supporting Organizations
Letters of support from applied R&D partners must accompany the application.

Application Procedures
The program would be available only to Ontario Colleges of Applied Arts and Technology. Applications would be submitted to the Ministry of Research and Innovation.

Selection Criteria
Applications are evaluated on the basis of the following criteria:

- **Scientific/technical merit:** The project must be scientifically sound, technically feasible, and promise to generate new knowledge, build capacity, or apply existing knowledge in an innovative manner.

- **Research competence:** The research team and partner organization must demonstrate that they possess the collective expertise to address the defined objectives competently and to complete the project successfully.

- **Relevance:** The proposal must identify how the work will benefit both the partner organization and the college, and demonstrate that the exploitation of project results will contribute to Ontario's productivity and/or prosperity.

- **Partner support:** The partner organization must contribute an appropriate amount from its own resources to the project, consistent with the risks and rewards involved and be in a position to exploit project results.

Reporting

A final report will be required upon completion of the project. The applied research partner will also be asked to provide comments on the project's success.

Budget

Colleges would be able to apply for grants on an as needed basis, ranging from $10,000.00 to $100,000.00, beginning in fiscal 2006-07.

Resource Needs

Year I funding of $1 million per year, increasing to $5 million in Year V.

Results Expected

- Stronger links and alliances among and between colleges and firms and organizations within local and regional economies and traded clusters that will facilitate long-term exchange and exploitation of knowledge and know-how, strengthening the innovative capacity of Ontario's economy.

The cost of these three programs is estimated to be $50 million over the first five years of a 10-year development plan, with an annual cost of $6 million in Year I of funding (2006/07), increasing to $18 million in Year V (2010/11).

The budget allocations in the second five year period would be dependent upon a review of the accomplishments, outcomes and impacts generated within the first five years of funding.

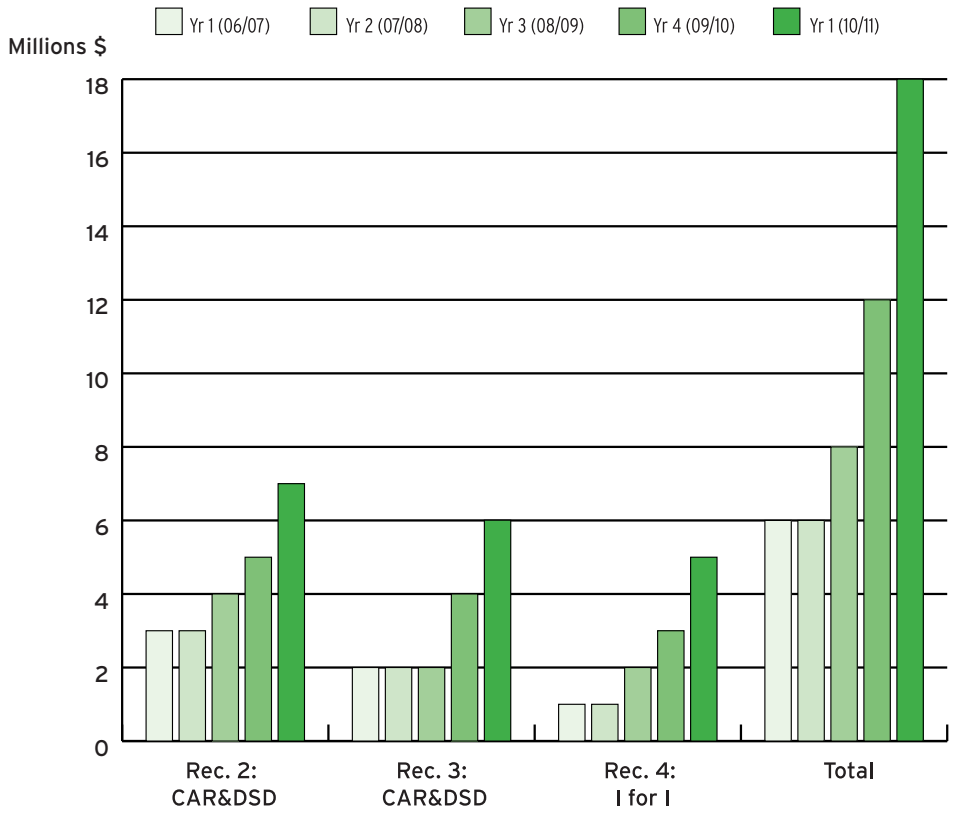
Table 2 illustrates the annual estimated cost of the proposed programs from 2006/07 to and 2010/11.

Table 2: Program Funding Recommended per Year to 2011

Programs	Yr 1 2006/07 ($ millions)	Yr 2 2007/08 ($ millions)	Yr 3 2008/09 ($ millions)	Yr 4 2009/10 ($ millions)	Yr 5 2010/11 ($ millions)	Program Totals
Rec. 2: CAR&DSD	3	3	4	5	7	22
Rec. 3: CAR&DP	2	2	2	4	6	16
Rec. 4: I for I	1	1	2	3	5	12
Total	6	6	8	12	18	50

Figure 2 illustrates the estimated cost of each proposed program to 2011.

Figure 2: Program Funding Summary: 2006/07 to 2010/11



Within an enabling policy and program framework, Ontario colleges can fully assume the role of industry and community catalyst for applied R&D and innovation and leverage their extensive links with partners across the province to create a unique 21st century competitive advantage for Ontario.

ACAATO is committed to working with the Ministry of Research and Innovation to refine the details of each of the recommended program investments.

5. RESULTS EXPECTED

Small and medium-sized businesses remain key engines of economic growth – taking risks, seizing opportunities, creating jobs. Yet, an "innovation and commercialization gap" persists between new knowledge arising from Ontario's research efforts and the needs of the market. Colleges and universities are both important sources of research in Ontario because the innovation and commercialization gap is so large. Colleges, which are currently underutilized resources for applied research and commercialization, are poised to increase their contribution to the transformation of knowledge into commercially viable products and services across the Ontario economy.

The applied R&D capacity-building strategy proposed for Ontario colleges will launch a **decade of development** that will cement colleges' roles as community-based catalysts of innovation. It will also position colleges as leaders in the effort to engender a flourishing innovation culture across Ontario.

If the recommendations and modest funding requests outlined above are not acted upon, what are the consequences? Simply put, Ontario will not realize its productivity and prosperity goals to the degree possible.

Without addressing the systemic barriers to the development of college applied R&D and innovation capacity, Ontario colleges will enter the 21st century providing 20th century training and only a limited ability to catalyze productivity and prosperity through applied R&D and workplace innovation.

Measurable outcomes and results of the proposed recommendations include:

- An increase in colleges' institutional capacity to support applied R&D, innovation and commercialization activities;
- An increase in the number of employers exposed to and participating in applied R&D and innovation activities;
- An increased number of college applied R&D and innovation projects;
- An increase in the amount of industry and community investment in applied R&D and innovation partnerships;

"I have two goals as Minister of Research and Innovation: First, I want to support the process of innovation. And second, I want to create a culture of innovation."

Premier Dalton McGuinty

Remarks at the opening of MaRS Discovery District
Toronto,
26 September 2005

- An increase in college students' experience in and understanding of the processes underlying applied R&D, innovation and entrepreneurship by incorporating applied research and innovation activities into curricula and supporting student participation in college-industry research partnerships; and

- An increase in college sector outreach to industry and community partners to create applied R&D and workplace innovation partnership opportunities.

As part of the terms and conditions of funding between the Province and individual colleges, specific measures and deliverables would be developed to facilitate the monitoring of progress toward milestones, outcomes and impacts.

"Every human being has something creative to contribute to society. The key is unlocking the creative potential inside every person, every institution, every company, finding a way to harness it and unleash it on the world. If we can reach that goal in Ontario then nothing will be beyond Ontario's reach."

Premier Dalton McGuinty
Minister of Research and Innovation

ww.mri.gov.on.ca/english/excels/stories.asp

6. CONCLUSIONS

Ontario's economic productivity, competitiveness and growth in the 21st century depend on investments in three critical areas: highly qualified people, ideas (research and development), and the adoption and diffusion of new technologies. Compared to many other jurisdictions, Ontario is underutilizing its college system's potential to contribute to enhancing Ontario's capacity in all three of these key areas.

Ontario colleges already contribute significantly to the development of highly qualified, entrepreneurial personnel. They are committed to building their capacity to contribute to the creation, adoption and diffusion of new technologies through applied R&D and workplace innovation activities.

Applied research in colleges bridges the gap between publicly-funded research and its practical and industrial application. Through applied research and innovation activities, Ontario colleges enhance the competitiveness and productivity of Ontario firms *and* provide advanced training opportunities, thus meeting the changing needs of firms and organizations in key sectors of Ontario's economy.

Looking ahead to needs of the economy through to 2011, Ontario colleges seek to increase their future contributions to economic competitiveness and a high performing society by strengthening and expanding their capacity to perform applied R&D and innovation. The goal of Ontario's colleges in the applied research, innovation and commercialization field is not to duplicate efforts, but to increase collaboration among all postsecondary institutions, industry, organizational partners and government to stimulate innovation to the greatest extent possible.

The recommendations contained in this report represent a critical first step in a multi-year strategy to expand the role of colleges as catalysts for applied R&D and innovation that will enable Ontario to better meet its needs for increased productivity and prosperity in the 21st century.

APPENDIX A: EXAMPLES OF APPLIED RESEARCH INITIATIVES AT ONTARIO COLLEGES RELEVANT TO PROVINCIAL INVESTMENT PRIORITIES

Provincial Research Investment Priorities	Applied Research Initiatives	College/Facilities	Outcomes to Date
Materials and Advanced Manufacturing	*Microbiological Method Development to Evaluate Textile Contamination by Microorganisms*	La Cité	Undertaken in partnership with Centre de technologie textile (CTT)
	Applied Research Centre for Integrated Advanced Manufacturing Technologies	Conestoga	A Materials and Manufacturing Ontario (MMO) research project completed; one MMO research project in progress
	Fabrication of GLARE Fibre Metal Laminate Test Cylinders	Confederation	Tested new fibre metal laminate material for feasibility in the manufacture of aircraft fuselages in collaboration with the National Research Council & Carleton University. Almost the entire fuselage of new Airbus A380 aircrafts is now made of this stronger, lighter, more durable material
	Applied manufacturing innovations – mechanical soldering	George Brown	In partnership with Circuit Centre, Toronto, ON, creating a prototype and production-ready version of a new manufacturing product

Provincial Research Investment Priorities	Applied Research Initiatives	College/Facilities	Outcomes to Date
Materials and Advanced Manufacturing	*Tribological Aspects of the Hydroforming Process*	Georgian	One Ontario Innovation Trust (OIT) project in progress. One MMO approved and starting soon
	Feasibility Study: Optimizing Lubrication Process in Aluminum Impact Extrusion	Georgian	One MMO project nearing completion
	Bioproducts Applied Research and Innovation	Lambton	Ontario Bioproducts Innovation Network currently in start-up phase, in collaboration with BCIP. It is a regional economic redevelopment network of agricultural, chemical and automotive industries
	Modern Foundry Technologies	Mohawk	Development and analysis of special alloys including stainless steels for SMEs
	Laser Plant Cutting Technology	Niagara	IP protection underway for applied research results
	Advanced Manufacturing and Design Technologies Centre	Sheridan	Training, education and research for industry needs

Provincial Research Investment Priorities	Applied Research Initiatives	College/Facilities	Outcomes to Date
Information and Communication Technologies	*Digital Media Research*	Algonquin	Working with local film and video production companies on transition to HiDef Digital Cinema and HDTV, and with TV production equipment manufacturer on product development for HDTV
	Wireless Internet Access for Rural and Remote Communities	Algonquin	Configured and tested simple, low-cost WiFi solutions for broadband access, and developed manual for community groups wishing to implement these solutions, deployed by Industry Canada, CIDA
	Determinants of Institutional Readiness for Distance/Distributed Learning	Boréal	Identified best practices
	Microbiological Method Development to Evaluate Textile Contamination by Microorganisms	La Cité	Undertaken in partnership with Centre de technologie textile (CTT)
	Fabrication of GLARE Fibre Metal Laminate Test Cylinders	Confederation	Tested new fibre metal laminate material for feasibility in the manufacture of aircraft fuselages in collaboration with the

Provincial Research Investment Priorities	Applied Research Initiatives	College/Facilities	Outcomes to Date
			National Research Council & Carleton University. Almost the entire fuselage of new Airbus A380 aircraft is now made of this stronger, lighter, more durable material
Information and Communication Technologies	*Development of a custom Learning and Content Management System (LCMS) for the Ontario college context*	Boréal	Developed functional Learning & Content Management System and have on-going research
	Best practice in implementation of technology in distance education	Boréal	Developed implementation model
	Improving Access for New Health Care Professionals	Centennial	Innovations in on-line mentoring for health professional newcomers to Ontario
	Innovations in Wireless Health Records	Centennial	Developing prototype database format for secure health record keeping, adapted for wireless and hand-held usability
	The LORI Project	Centennial	Development and evaluation of an Online Learning Object Review Instrument

Provincial Research Investment Priorities	Applied Research Initiatives	College/Facilities	Outcomes to Date
Information and Communication Technologies	*Wireless Travel Guide*	Centennial	Concept design completed, functional specifications in progress
	High Performance Computing (SHARCNet) Consortium	Fanshawe	Networked research in high performance computing applications
	Wireless Tracking for Long-Term Care Patients & Equipment	Fleming	Prototype was miniaturized and commercialized by an industry partner
	Micro-electronics product development testing	George Brown	Working with a range of partners including Research In Motion (RIM), Waterloo, ON and Seimens to develop and test product enhancements and production equipment
	Software for Chemical Process Operators	Lambton	Applied research currently underway
	Virtual Reality Technology for Land Use Planning		Applied research currently undertaken has positioned Ontario/Canada at the forefront of 3-D visualization innovations
	Technologies to Improve Group Decision-making	Niagara *Centre for Advanced Visualization*	Applied research currently underway in partnership with community-based organizations

Provincial Research Investment Priorities	Applied Research Initiatives	College/Facilities	Outcomes to Date
Information and Communication Technologies	*"On-the-Fly" Wireless File and Data Sharing Networks*	Mohawk *Procor Decision Support Centre*	Prototype being adapted by software development partner for healthcare applications
	Software Enabling National Real-time Access to Canadian Microelectronics Laboratories	St. Lawrence	Applied research currently underway with national partners
	Internet-based Curricula for Secondary School Teacher In-service Education	St. Lawrence	Research outcomes were copyrighted and licensed to school boards, used as on-line Additional Qualification (AQ) courses in the York University Faculty of Education
	Interactive Digital Television	Seneca *Seneca College-York University Technology Enhanced Learning Institute (TELi)*	Spin-off company established, commercialization in process
	Networks of Interactive Digital Media	Sheridan *Visualization & Design Institute*	A number of additional applied research projects are currently protected by non-disclosure agreements.
	Industrial Design	Sheridan	Applied research commencing

Provincial Research Investment Priorities	Applied Research Initiatives	College/Facilities	Outcomes to Date
Information and Communication Technologies	*Visualization and Design*	Sheridan	Development and dissemination of new design tools, instruments and services
	Hapto-Visual Research	Sheridan *Visualization & Design Institute*	An Interactive Virtual Environment Laboratory focuses on developing solutions for extracting meaningful information from databases using three dimensional visualizations and simulations that respond to real-time user inputs
Life Sciences/ Biotechnology	*Infection Control*	Algonquin	Worked with industry partners and university researchers on prototypes of computer-based training systems including haptics (touch); development of tele-haptics (touch over networks); and virtual haptics (touch in VR) for applications such as surgical training
	Healing Outcomes Searchable Database	Centennial	Province-wide online training for health professionals

Provincial Research Investment Priorities	Applied Research Initiatives	College/Facilities	Outcomes to Date
Life Sciences/ Biotechnology	*Massage Therapy for Hospitalized High-Risk Pregnant Women: A Pilot Study*	Centennial	Creation of a national searchable database for research instruments that measure healing
	Patient Education Project – "PEP TALK"	Centennial	Randomized controlled pilot trial investigating the reduction of stress and anxiety in hospitalized high-risk pregnant women through the use of a massage therapy intervention
	Air Quality Impacts on Human Health	Centennial	Delivering patient education through an online, archived interface
	Acquired Brain Injury Support Systems	Fanshawe *Air Quality Research Lab*	Applied research currently underway in partnership with the Ontario Ministry of the Environment, medical devices companies, and regional health care facilities
	Ultra-sensitive ultra-sound device	Fanshawe	Applied research currently underway
	Biopharmaceuticals/ Natural Health Products	George Brown	Developed a prototype for the electronic component of an ultra-sensitive ultra-sound device providing fine detail without invasive surgery, in collaboration with Sunnybrook Medical Centre

Provincial Research Investment Priorities	Applied Research Initiatives	College/Facilities	Outcomes to Date
Life Sciences/ Biotechnology	*Respiratory Virus Vaccines*	Loyalist *Supercritical Carbon Dioxide (CO_2) Extractor Lab*	Applied research currently underway with industry and university partners
Energy	*Green Energies and Biotechnologies*	Seneca *Biotechnology Centre for Applied Research and Training*	Applied research currently underway in partnership with a range of companies and university medical research centres
	Use of Biodiesel in Diesel Engines	Boréal	Project funding and partnerships under development
	Sustainable/Alternative Energy Centre	Boréal	Project completed
	Distributed and Renewable Generation/Integration in Urban Environments	Cambrian	Funding drive underway to build an applied research centre in energy technologies
	Green Energy and Environmental Technologies Network (GrEEN)	Centennial *Centre for Sustainable Energy Integration*	Vertical axis wind turbine prototyping and testing
	Using Harvest Biomass as Bio-Energy	Centennial and partners	Daylighting system performance validation

Provincial Research Investment Priorities	Applied Research Initiatives	College/Facilities	Outcomes to Date
Energy	*Solar Energy Panel Innovations*	Confederation	Consortium proposed, partnership development in progress
	Energy Conservation and Efficiency in Hand Dryers	St. Lawrence *Solar Energy Research Lab & "Energy House" (public education centre)*	Phase 1 pre-feasibility study complete. Phases 2-3 (field trials & model development) underway
	"Green" Buildings	St. Lawrence *"Energy House"*	Applied research currently underway in partnership with global engineering and product manufacturing companies
Environmental Technologies	*Role of Colleges in supporting knowledge clusters for economic development related to forest resources*	Algonquin	Applied research currently underway
	Wildlife Management	Boréal	Working on research proposals in the areas of solar panel instrumentation and monitoring, and advanced housing construction methods and materials
	Built Environment Research and Education Centre	Cambrian	Funded through ACCC by Rural Secretariat and others in conjunction with College of the Rockies, BC and Nova Scotia Community Colleges

Provincial Research Investment Priorities	Applied Research Initiatives	College/Facilities	Outcomes to Date
Environmental Technologies	*Energy Efficient Multi-Unit Residential Building Ventilation*	Conestoga	Funded through ACCC by Rural Secretariat and others in conjunction with College of the Rockies, BC and Nova Scotia Community Colleges
	Large Scale Digital Photography	Conestoga	Collaboration between Conestoga and University of Waterloo - set up of infrastructure underway
	Drone Technology for Forest Monitoring and Assessment	Confederation	NRCAN project currently in start-up phase.
	Impacts of Riparian Harvest on Aquatic Ecosystems	Confederation	OIT, Bowater, OMNR, Lakehead University - applied research currently underway
	Air Quality Impacts on Human Health (see also Life Sciences/ Biotechnology)	Confederation	OIT, Bowater Inc, OMNR – in progress
	Alternative Wastewater Treatment using Constructed Wetlands	Fanshawe *Air Quality Research Lab*	OMNR & Province of Saskatchewan - Technical Note under peer review, to be published spring 2006

Provincial Research Investment Priorities	Applied Research Initiatives	College/Facilities	Outcomes to Date
Environmental Technologies	*Social support for students, its forms and influences*	Fleming *Centre for Alternative Wastewater Treatment*	Applied research currently underway in partnership with the Ontario Ministry of the Environment, medical devices companies, and regional health care facilities
Social/Service Innovations	*Immigration Assessments On-line*	Boréal	Applied research currently underway
	Learning Disabilities Assessment	Cambrian	Start up stage (seeking funding)
	Turning Point for Teens	Cambrian	Applied research grants being sought to develop the technologies necessary to support additional research
	Diversity: An essential employability skill for the 21st century	Cambrian	Research on the effectiveness of a screening tool as a predictor of learning disabilities as compared to results ascertained through extensive testing
	The relationship of educational and work-related factors on the occurrence of medication administration errors by novice paediatric nurses	Centennial College	Collaborative applied research being undertaken in collaboration with the Ministry of Health and Long-Term Care and the Outreach Program for Eating Disorders

Provincial Research Investment Priorities	Applied Research Initiatives	College/Facilities	Outcomes to Date
Social/Service Innovations	*Nursing Clinical Simulation Initiative*	Durham	A case study analysis of developing and integrating core diversity competencies and learning outcomes into all college career related educational programs
	Tourism Ontario Development Initiative	Durham	Study will test the impact of workload on outcomes and adverse events for patients, novice nurses, and hospitals in relation to paediatric medication errors for novice paediatric nurses
	Restorative justice strategies to reduce the number of child re-offenders	George Brown	An enhanced clinical simulation model for virtual clinical excursions developed in collaboration with The University of Ontario Institute of Technology (UOIT) & Durham College (DC) Collaborative BScN program. Evaluation of the clinical simulation model in increasing student's clinical competency & confidence will be undertaken with research support from Reed Elsevier.
	*Internet-based Curricula for Secondary School Teacher In-service Education** (see also	George Brown	A college – university research team, lead by The Canadian Institute of Advanced Culinary Arts at George Brown Chef School,

Provincial Research Investment Priorities	Applied Research Initiatives	College/Facilities	Outcomes to Date
	Information and Communications Technology)		produced a Culinary Tourism Strategy research report for the Ontario Ministry of Tourism as part of a three-year research project funded by the Ministry of Tourism.
	Elder Research	Seneca *Seneca College-York University Technology Enhanced Learning Institute (TELi)*	Research explores whether or not restorative justice techniques are effective in reducing the risk that children younger than 12, who had been in trouble with the law, would re-offend.
Social/Service Innovations	*Youth and Women in First Nations Communities*	Sheridan *Sheridan Elder Research Centre (SERC)*	Research outcomes copyrighted and licensed to school boards, used as online Additional Qualification (AQ) courses in the York University Faculty of Education SERC will identify, develop, test and support the implementation of innovative strategies that improve the quality of life for older adults and their families
		Sheridan	Studies on various issues in First Nations communities

APPENDIX B: EXAMPLES OF ONTARIO COLLEGE APPLIED RESEARCH/COMMERCIALIZATION PARTNERS

AVAYA
Biorem Technologies
Bowater
Buchanan Forest Products
Canadian Microelectronics Corporation
Circuit City
Conservall Engineering
Coperion
CTD Photonics
Delcan Industries
Desire 2 Learn
Dofasco
Endeavor (software company)
Fischer Scientific
University of Guelph
Handshake Interactive Technologies Inc.
Hewlett-Packard
Lakeside Controls
Lanxess (Bayer Polymers)
Laurentian University
Luxwell Inc.
Many small businesses (with less than 15 employees)
McGraw Hill-Ryerson Publishing
Mitel Networks
MPB Communications
Municipalities and cities in Ontario (Welland, Burlington)
National Capital Institute of Telecommunications
National Research Council
Nortel
Northern Centre for Advanced Biotechnology (Neureka)
Pearson Publishing
Peterborough DNA Cluster
Pro Sum Solutions
Procor
Research in Motion (RIM)

Sansys (IT and engineering company)
SGS Lakefield Research
Siemens Miltronics
SMA Biometrics
SNC-Lavalin
Stelco
SUN Microsystems
Sunnybrook Medical Centre
Testmark Industries
The River Institute
Toronto East General Hospital
Trent University
University of Toronto
US clients in land use planning
Walker Industries
Weyerhauser Forest Products
WimCare
York University, Faculty of Education

College's public sector applied research partners include:
Bioproducts Innovation Network;
Canadian International Development Agency (CIDA);
Canada Foundation for Innovation (CFI);
High Performance Computing (SHARCNet) Consortium
Industry Canada;
Ontario Innovation Trust (OIT);
Ontario Research and Development Challenge Fund (ORDCF);
Ontario Centres of Excellence, Inc.
Communications Information Technology Ontario (CITO) Network;
CRESTech
Materials and Manufacturing Ontario (MMO)
Photonics Research Ontario (PRO)
Ontario Ministry of Economic Development and Trade;
Ontario Ministry of the Environment;
Ontario Ministry of Natural Resources;
Ontario Ministry of Tourism
Province of Saskatchewan;
A selection of municipalities and regions.

APPENDIX C: EXAMPLES OF POLICY APPROACHES TO FACILITATE COLLEGE RESEARCH IN OTHER CANADIAN JURISDICTIONS

In other jurisdictions, colleges have emerged among the leading tools of provincial governments for innovation and economic growth.

For example, in **British Columbia**, the B.C. Institute of Technology (BCIT) is strengthening its ability to bring technology to the marketplace through a newly formed Technology Commercialization Office. The Office is funded in part by Western Economic Diversification Canada, and ensures marketable innovations are commercialized. This office is building a framework for protecting and licensing intellectual property developed by BCIT and will expand its support to all areas of research at BCIT, forging new alliances with industry to spur innovation and commercialization of innovative technologies by BCIT, its clients and partners.

Immediate goals for the new office include developing commercialization plans for several BCIT-developed technologies. Future programs will address many of the critical issues that affect the success of new technologies and entrepreneurship, including intellectual property protection, business planning, investor presentations and commercial development requirements.

In **Alberta**, the Olds College Centre for Innovation was established in June 1999 and was the first Applied Research Organization at a College in Western Canada. In 2004, OCCI had four full-time PhD Scientists, Senior Engineers, Technicians and Administrators for a total of 16 staff. OCCI developed four key areas of applied research: Bioenergy (composting and waste management), Bioprocessing (new products from crops), Environmental Microbiology and Livestock (nutrition, breeding and genetics).

In addition, OCCI has made significant contributions to College education by engaging faculty and students in applied research projects, and supporting release time by offering part-time and full-time employment assignmnets. Applied research has enabled the college to build capacity for innovation in the agri-food and agriculture sector. Since the development of OCCI, several other Alberta Colleges have developed similar applied research programs in their areas of expertise with OCCI providing advice and support. For example, OCCI, Red Deer College and the Southern Alberta Institute of Technology were instrumental in the development of

an applied research project fund supported by Western Diversification and accessible by all Alberta Colleges. Since 1999, OCCI has completed more than 80 applied research projects.

In **Quebec**, the Collèges d'enseignement général et professionnel (CEGEP) offer two different types of programs: 2 year pre-university programs leading to university enrolment and 3 year professional/vocational programs that prepare graduates for entry into the labour market. There are 48 public CEGEPs (43 French-speaking and 5 English-speaking) located in large and medium-sized centres across the province. There are also 22 private subsidized institutions under the responsibility of the Education Ministry (16 French-speaking and 6 English-speaking). Although college research is a relatively recent phenomenon, college research is recognized under the Act respecting CEGEPs and for several years the Ministry of Education, Quebec, has been allocating funds for teaching release for CEGEP professors conducting research. College professors have proven themselves to be key members of university research teams and/or research centres. The intellectual research resources within CEGEPs are being purposefully integrated into Quebec's research and innovation networks, given their important contributions to provincial innovation efforts.

The importance of CEGEPs in regional development also led to the creation of a network of 28 College Centres for the Transfer of Technology (CCTT), each affiliated with a CEGEP, forming a Quebec-wide network designed to benefit the companies of a given sector through the expertise of instructors and CEGEPs involved.

The CCTTs are staffed by technology transfer experts that review the needs and requests of individual firms and call on the expertise of interested teachers active in the technical speciality concerned. CCTTs operate as independent corporations with their own board of directors that include representatives of local CEGEPs and of the industrial sector concerned. CCTTs are funded in part by allocations from the Ministry of Education and in part by the revenues from the services sold to companies. In collaboration with the dynamic elements of each CEGEP, efforts are being made to develop a network of CCTTs that meet the requirements of each of the major technical sectors of Quebec's economy.

NOTES

[1] Ontario Council on University Affairs, Task Force on Resource Allocation, *Technical Paper: An Analysis of the Costs of Teaching, Research and Community Service – An Estimation Model for the Ontario University System*, August 1994. Based on existing financial models and financial reports produced by the Council of Financial Officers of the Universities of Ontario (COFO-UO), the Ontario Council on University Affairs (OCUA) determined that of the $3,990 million spent by the Ontario university system in 1992-93 from all sources, about 53 per cent ($2,118 million) was spent on teaching activities, 36 per cent ($1,432 million) was spent on research and 11 per cent ($440 million) was spent on community service (the cost of secondary functions were spread over the three primary functional areas). Of the total amount spent on research from all sources, OCUA estimated that 61% of the cost (or $973 million) of University research came from the Ontario Operating Grant and was primarily used to cover the cost of salaries.

[2] Statistics Canada, *Survey of Intellectual Property Commercialization in the Higher Education Sector*, 2003, November 2003.
See:http://dsp-psd.pwgsc.gc.ca/Collection/Statcan/
88F0006X/88F0006XIE2005018.pdf

[3] "College Sector Resources, ACAATO Environmental Scan, 2006.
http://www.acaato.on.ca/home/postsecondary.html

[4] Achieving High Expectations in Ontario's Postsecondary Sector: A Plan for Change, November 2004, p. 2, downloaded 6 November 2005 from: http://www.acaato.on.ca/home/postsecondary/primaryInternalContentParagraphs/01/document/RaeReviewSubmission.pdf

[5] ACAATO retained CCbenefits Inc. to determine the socio-economic benefits of the Colleges of Applied Arts and Technology. "College Sector Resource Requirements," Working Paper, October 2004, page 7, downloaded 21 October 2005 from: http://www.acaato.on.ca/home/postsecondary.html

[6] Ontario Colleges' Applied Research and Commercialization Capacity: September 2004 Survey Results, CON*NECT September 14, 2005.

[7] To view the provincial and national locations, wages, regional shares and North

American comparison of traded clusters see the Institute for Competitiveness and Prosperity web-site at: http://www.competeprosper.ca/clusters/mapcluster.php.

[8] The combination of technical and human resource/training assistance that can be provided by Ontario colleges follows the general prescription for SME strength recommended by MIT professor Paul Osterman. See Paul Osterman, *Revolutionary Work*, Blueprint Magazine, June 1, 2000.

[9] *Measuring Industrial R&D: Comparing Canada with the G-7*, Statistics Canada, Innovation Analysis Bulletin, Vol. 7, No. 3, October 2005, p. 5. Canada produces approximately 2% of the R&D conducted world-wide and Ontario conducts approximately half of all R&D conducted in Canada.

[10] Olds College, 2004, Report to CFI for the year April 2003 to March 2004. Downloaded 22 October 2005, from: http://www.innovation.ca/evaluation/2004/Olds.pdf

[11] *Towards a Québec Innovation Policy, To Understand and To Innovate, Assuring Competitive Means for University Research*, Advisory Report of the Conseil de la science et de la technologie, Government of Quebec, 2002. Downloaded on 22 October 2005 from: http://www.cst.gouv.qc.ca/html/reConnInnov.html and *Innovation —A catalyst for prosperity,* Political Priority Actions Concerning The Knowledge-Based Economy, a government at the service of Quebecers, Working Document, March 2003, Liberal Party, Quebec. Pp 18-19. Downloaded on 22 October 2005, from: http://www.plq.org/doc/platform/innovationa.pdf